

# A search for emission line galaxies at $z = 6.5$

Jaron Kurk<sup>1</sup>, Andrea Cimatti<sup>1</sup>, Sperello di Serego Alighieri<sup>1</sup>, Joël Vernet<sup>1</sup>, and Emanuele Daddi<sup>2</sup>

<sup>1</sup> INAF – Osservatorio Astrofisico di Arcetri, Largo E. Fermi 5, 50125, Firenze, Italy

<sup>2</sup> ESO, Karl-Schwarzschild-Str. 2, 85748, Garching bei München, Germany

**Abstract.** We are carrying out a search for Ly $\alpha$  emitting galaxies at  $z = 6.5$  employing slitless spectroscopy at the VLT. In our 43 arcmin<sup>2</sup> field we find three isolated single emission lines with SEDs consistent with line emitting galaxies at  $z = 6.5$ .

## 1 Introduction

Since the discovery of  $z \sim 3$  Lyman Break Galaxies (LBGs [1]), many efforts are being made to select the whole population of star-forming galaxies at the highest possible redshifts (see [2] for a review), and to constrain the star formation history of the universe (e.g. [3]). The detection of  $z > 6$  galaxies allows to study the modes of early galaxy formation and the interplay between the first galaxies and the intergalactic medium (IGM). The redshift range  $6 < z < 7$  is a very intriguing time during cosmic evolution, when hydrogen reionization is believed to be basically complete and the IGM starts to be polluted with metals [4,5].

Because a significant part of the bolometric luminosity of primeval star-forming objects escapes as Ly $\alpha$  emission, especially if dust is not yet ubiquitous, it seems profitable to search for the redshifted Ly $\alpha$  line of high redshift galaxies. The advent of ten meter class telescopes made this approach successful and efficient, and both narrow-band imaging and optical *serendipitous* spectroscopy found Ly $\alpha$  emitters at  $3 < z < 6$  [2,6,7]. Thanks to the recently increased sensitivity of CCDs at  $\lambda > 0.8\mu\text{m}$ , the discovery of  $z > 6$  galaxies has also become possible. Using narrow band filters sensitive to wavelengths in the range  $9100 < \lambda < 9250\text{Å}$ , i.e. Ly $\alpha$  emission at  $z \sim 6.5$  and subsequent spectroscopy, two groups have detected the first three galaxies known at  $z > 6$ . The first of these was found due to the strong lensing amplification (4.5) by the cluster Abell 370 [8]. The other two galaxies were found in a survey made with Subaru Suprime-Cam instrument which provides a huge field of view (814 arcmin<sup>2</sup> [9]).

## 2 Observations and analysis

We have used a new approach to search for Ly $\alpha$  emitters at  $z \sim 6.5$  based on slitless spectroscopy in combination with a narrow band (2.2%) filter and very deep imaging in a field with very low Galactic extinction ( $E_{B-V}=0.002$ ). The  $z_{sp}$  filter employed has a central wavelength of 9135 Å and FWHM of 200 Å and is therefore sensitive to Ly $\alpha$  at  $6.44 < z < 6.61$ . The imaging was carried out

through the  $z_{sp}$  filter (to identify the sources of emission lines detected in the spectroscopy) and the Bessel  $I$  filter (to determine the  $I - z$  colour or spectral break over the  $\text{Ly}\alpha$  line). The observations were carried out with the FORS2 instrument at the VLT during eight nights in October, November 2002 and February 2003. Total exposure times were 7.6, 6.33 and 4.0 hours for the slitless spectroscopy,  $z_{sp}$  and  $I$  band direct imaging, respectively. Observing conditions were excellent resulting in 0.7 arcsec seeing on the resulting combined images. The field was also imaged earlier in Bessel  $U$  and Gunn  $v$  band.

Three authors (JK, AC, SSA) have independently searched for emission lines on the spectroscopic frame, resulting in a combined list of 161 emission lines. Each emission line can originate from a counterpart on the direct image within a region of about  $50'' \times 1''$ . The emission lines are related to 345 possible counterparts in the  $z_{sp}$  image. Four of these have  $I - z_{sp} > 1.5$ , one of which is an [OIII] emitter at  $z = 0.82$ . This leaves three counterparts which may be  $\text{Ly}\alpha$  emitters at  $z \sim 6.5$ . Furthermore, among the  $\sim 4500$  objects detected by SExtractor on the  $z_{sp}$  image, there are ten other objects with these colours, which are considered LBG candidates at  $z > 6$ .

### 3 Conclusions and future work

The number of possible  $\text{Ly}\alpha$  emitters at  $z = 6.5$  detected in our field is consistent with the number densities of  $z > 5.5$  galaxies reported by other authors [2,6]. In particular, the recent Subaru survey by [9] resulted in the detection of 73  $\text{Ly}\alpha$  candidates at  $z = 6.5$  (with  $i' - z' > 1.3$ ) in an  $814 \text{ arcmin}^2$  field. Based on this result, we expect to find in our available  $43 \text{ arcmin}^2$  field three candidate  $\text{Ly}\alpha$  emitters at  $z = 6.5$ .

Slitmask spectroscopic observations are needed to confirm the identity of the candidate  $\text{Ly}\alpha$  emitters and the LBGs. These observations will provide higher signal to noise and higher spectral resolution to measure the characteristic asymmetric line profile of  $\text{Ly}\alpha$  at high redshift. The larger wavelength coverage will allow the detection of emission lines from the presumed LBGs outside the  $z_{sp}$  filter. Time has been allocated to carry out these observations with FORS2.

### References

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